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EXAMINER

BOYER, RANDY

ART UNIT

PAPER NUMBER

1771

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**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

<b>Office Action Summary</b>	<b>Application No.</b> 10/738,332	<b>Applicant(s)</b> MESTERS ET AL.	
	<b>Examiner</b> RANDY BOYER	<b>Art Unit</b> 1771	

**-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --**

### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 20 January 2011.
- 2a) ☒ This action is **FINAL**.                      2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 1,2,9,11-21,24-26,30,33-53 and 65-94 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1,2,9,11-21,24-26,30,33-53 and 65-94 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All    b) ☐ Some \*    c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- |  |   |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)          | 4) <input type="checkbox"/> Interview Summary (PTO-413)           |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____                                      |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)          | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date _____  | 6) <input type="checkbox"/> Other: _____                          |

## **DETAILED ACTION**

### ***Response to Amendment***

1. Examiner acknowledges Applicant's response filed 20 January 2011 containing amendments to the claims and remarks.
2. Claims 1, 2, 9, 11-21, 24-26, 30, 33-53, and 65-94 are pending.
3. The previous grounds for rejection under 35 U.S.C. 103(a) in view of De Jong (US 5,720,901) and other secondary references are withdrawn in view of Applicant's amendments to the claims.
4. The previous grounds for rejection under 35 U.S.C. 103(a) in view of Frame and other secondary references are maintained.
5. New grounds for rejection, necessitated by Applicant's amendments to the claims, are entered under 35 U.S.C. 103(a). The rejections follow.

### ***Claim Rejections - 35 USC § 103***

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office Action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which

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said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

7. The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

8. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

9. Claims 1, 2, 9, 11-21, and 24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Frame (US 3,978,137) in view of Yoo (US 3,945,914), Mahadev (WO 92/20621), and Mackrodt (US 5,137,862).

10. With respect to claims 1, 2, 9, 11-19, 21, and 24, Frame discloses a process comprising contacting a hydrocarbon feedstock containing mercaptan compounds with

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air and a catalyst comprising<sup>1</sup> platinum, rhodium, or iridium on a zirconia support at a temperature between about 50°C and about 400°C at a pressure of about 1 atm (see Frame, column 1, lines 4-12; column 2, lines 42-45; column 3, lines 1-19; and column 4, lines 10-13 and 60-65).

Frame does not explicitly disclose wherein the feed is a gaseous feedstock containing at most 5 vol% hydrogen sulfide and where the feed mixed with the oxygen-containing gas has an oxygen-carbon ratio below 0.10. Frame also does not explicitly disclose wherein the platinum, rhodium, or iridium are present at a concentration in the range from 0.02% to 10% based on the weight of the catalyst; or wherein the zirconia support is one that has been stabilized or partially stabilized with yttria.

However, Mahadev discloses a feed stream of natural gas containing up to 10 wt% hydrogen sulfide (see Mahadev, page 1, lines 21-24; and page 2, lines 3-9). Mahadev explains that the adsorptive capacity of the catalyst remains unchanged for feeds with less than 10 wt% of hydrogen sulfide (see Mahadev, page 32, lines 3-9). In addition, Yoo explains that a hydrocarbon feed mixture of oxygen-containing gas has an oxygen-sulfur ratio of about 0.5 with the sulfur content of the feed being about 1 wt%. Because hydrocarbons comprise carbon atoms, 99% of the feed would contain carbon atoms. Thus, the oxygen-to-carbon ratio of the feed would be approximately 0.005 (see Yoo, column 1, lines 64-68; and column 2, lines 46-63). Yoo further explains that the

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<sup>1</sup> With respect to Applicant's previous amendment of the transitional phrase "comprises" to "consisting essentially of" to introduce the catalyst composition to be used in the claimed process, Examiner notes that "for the purposes of searching for and applying prior art under 35 U.S.C. 102 and 103, absent a clear indication of what the basic and novel characteristics [of the claimed invention] actually are, 'consisting essentially of' will be construed as equivalent to 'comprising.'" See MPEP § 2111.03.

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concentration of oxidant is usually dependent on the amount of sulfur present in the hydrocarbon material (see Yoo, column 2, lines 46-53). Finally, Mackrodt notes that yttria is conventionally incorporated into zirconia supports as a means of stabilizing the zirconia against the phase change and accompanying volume expansion of unstabilized zirconia at elevated temperatures (see Mackrodt, column 4, lines 2-7).

Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the process of Frame to include a feed stream of natural gas containing up to 10 wt% hydrogen sulfide (as taught by Mahadev) in order to preserve the adsorptive capacity of the catalyst. Furthermore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the process of Frame to provide an oxygen-carbon ratio of the feed of approximately 0.005 since the amount of oxygen present in the feed is dependent upon the amount of sulfur present in the feed (as evidenced by Yoo).

With respect to the claimed concentration of metals present in the catalyst, Examiner notes that differences in concentration will generally not support the patentability of subject matter encompassed by the prior art unless there is evidence to establish that such concentration is critical. See MPEP § 2144.05(II)(A).

Finally, with respect to Applicant's newly added limitation "with no or minimal oxidation of the non-sulfur containing hydrocarbon compounds," Examiner submits that such feature is inherent in the process of Frame inasmuch as: (1) Frame is directed to "a process for the oxidation of sulfur-containing compounds" (see Frame, column 2, lines 25-27) and hydrocarbon species *per se* are not "sulfur-containing compounds";

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and (2) Frame discloses the same oxidation conversion temperatures as specified in the instant application (see Frame, column 3, lines 1-3). When an examiner has reason to believe that the functional language asserted to be critical for establishing novelty in claimed subject matter may in fact be an inherent characteristic of the prior art, the burden of proof is shifted to Applicant to prove that the subject matter not shown in the prior art does not possess the characteristics relied upon. See MPEP § 2112(V) (citing In re Fitzgerald, 619 F.2d 67, 70 (CCPA 1980)).

11. With respect to claim 20, Mahadev discloses a flue gas having a concentration of sulfur dioxide in the range of 1000 ppm to 2000 ppm (see Mahadev, page 17, lines 7-9).

12. Claims 46, 47, 49, 50, 70-74, and 80-84 are rejected under 35 U.S.C. 103(a) as being unpatentable over Frame (US 3,978,137) in view of Yoo (US 3,945,914), Mahadev (WO 92/20621), and Madgavkar (US 4,382,912).

13. With respect to claims 46, 47, 49, 50, 70-74, and 80-84, Frame discloses a process comprising contacting a hydrocarbon feedstock containing mercaptan compounds with air and a catalyst comprising platinum, rhodium, or iridium on a zirconia support at a temperature between about 50 °C and about 400 °C at a pressure of about 1 atm (see Frame, column 1, lines 4-12; column 2, lines 42-45; column 3, lines 1-19; and column 4, lines 10-13 and 60-65).

Frame does not explicitly disclose wherein the feed is a gaseous feedstock containing at most 5 vol% hydrogen sulfide and where the feed mixed with the oxygen-containing gas has an oxygen-carbon ratio below 0.10. Frame also does not explicitly disclose wherein the platinum, rhodium, or iridium are present at a concentration in the

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range from 0.02% to 10% based on the weight of the catalyst; or wherein the support is a non-refractory oxide bulk material.

However, Mahadev discloses a feed stream of natural gas containing up to 10 wt% hydrogen sulfide (see Mahadev, page 1, lines 21-24; and page 2, lines 3-9). Mahadev explains that the adsorptive capacity of the catalyst remains unchanged for feeds with less than 10 wt% of hydrogen sulfide (see Mahadev, page 32, lines 3-9). In addition, Yoo explains that a hydrocarbon feed mixture of oxygen-containing has an oxygen-sulfur ratio of about 0.5 with the sulfur content of the feed being about 1 wt%. Because hydrocarbons comprise carbon atoms, 99% of the feed would contain carbon atoms. Thus, the oxygen-carbon ratio of the feed would be approximately 0.005 (see Yoo, column 1, lines 64-68; and column 2, lines 46-63). Yoo further explains that the concentration of oxidant is usually dependent on the amount of sulfur present in the hydrocarbon material (see Yoo, column 2, lines 46-53). Finally, Frame discloses wherein the support material may be selected from among alumina, silica, magnesia, and zirconia (see Frame, column 4, lines 61-64). In this regard, Madgavkar discloses the use of Fecralloy™ as a substitute for the support materials listed in Frame for the purpose of supporting oxidation catalysts (see Madgavkar, column 3, lines 16-37). Applicant admits that Fecralloy™ consists of Fe, Cr, and Al alloy with an alumina and zirconia surface layer (see Applicant's specification, page 4, lines 33-34; and page 5, lines 1-4).

Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the process of Frame to include a feed



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stream of natural gas containing up to 10 wt% hydrogen sulfide (as taught by Mahadev) in order to preserve the adsorptive capacity of the catalyst. Furthermore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the process of Frame to provide an oxygen-carbon ratio of the feed of approximately 0.005 since the amount of oxygen present in the feed is dependent upon the amount of sulfur present in the feed (as evidenced by Yoo). In addition, it is *prima facie* obvious to substitute one prior art element (Fecralloy™ as the non-refractory bulk oxide) for another prior art element (alumina, silica, magnesia, and zirconia) known to be useful for the exact same purpose (supporting an oxidation catalyst). See MPEP § 2144.06.

With respect to the claimed concentration of metals present in the catalyst, Examiner notes that differences in concentration will generally not support the patentability of subject matter encompassed by the prior art unless there is evidence to establish that such concentration is critical. See MPEP § 2144.05(II)(A).

Finally, with respect to Applicant's newly added limitation "with no or minimal oxidation of the non-sulfur containing hydrocarbon compounds," Examiner submits that such feature is inherent in the process of Frame inasmuch as: (1) Frame is directed to "a process for the oxidation of sulfur-containing compounds" (see Frame, column 2, lines 25-27) and hydrocarbon species *per se* are not "sulfur-containing compounds"; and (2) Frame discloses the same oxidation conversion temperatures as specified in the instant application (see Frame, column 3, lines 1-3). When an examiner has reason to believe that the functional language asserted to be critical for establishing novelty in

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claimed subject matter may in fact be an inherent characteristic of the prior art, the burden of proof is shifted to Applicant to prove that the subject matter not shown in the prior art does not possess the characteristics relied upon. See MPEP § 2112(V) (citing In re Fitzgerald, 619 F.2d 67, 70 (CCPA 1980)).

14. Claims 1, 2, 9, 11-21, and 24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Srinivas (US 7,060,233) in view of Mackrodt (US 5,137,862).

15. With respect to claims 1, 2, 9, 11-21, and 24, Srinivas discloses a process for the catalytic selective oxidation of a sulfur compound contained in a hydrocarbonaceous feedstock (e.g., natural gas, synthesis gas, natural gas liquids) to sulfur dioxide (see Srinivas, column 3, lines 17-20; column 4, lines 31-37; column 6, lines 7-11; and column 15, lines 40-45) comprising: contacting a mixture of a hydrocarbonaceous feedstock (see Srinivas, column 3, lines 17-20) containing any of various sulfur compounds (see Srinivas, column 3, lines 20-22; and column 4, lines 28-30) in an amount ranging from 100 ppm to 10,000 ppm (see Srinivas, column 23, lines 15-19) and an oxygen-containing gas (see Srinivas, column 5, lines 4-7) with a catalyst (see Srinivas, column 10, lines 14-26) at a temperature between about 160°C and 500°C (see Srinivas, column 4, lines 57-67; and column 5, lines 1-3) and a pressure in the range of 1 atm and 1000 psig (1.01 bar to 68.9 bar) (see Srinivas, column 6, lines 19-23), wherein the catalyst may comprise platinum, rhodium, or iridium in the range of 1 wt% to 10 wt% (see Srinivas, column 12, lines 56-59), supported on a catalyst carrier (e.g., zirconia) (see Srinivas, column 10, lines 27-30).

Srinivas does not explicitly disclose wherein the feed mixture has an oxygen-to-carbon ratio of below 0.10. Srinivas also does not explicitly disclose wherein his catalyst carrier is a zirconia that has been stabilized or partially stabilized with yttria.

However, Examiner notes wherein Applicant has defined “oxygen-to-carbon ratio” as “the ratio of oxygen in the form of molecules ( $O_2$ ) to carbon atoms present in the hydrocarbonaceous feedstock” (see Applicant’s specification, page 6, lines 17-19). In this regard, Srinivas discloses wherein the oxidizing gas is  $O_2$  (see Srinivas, column 5, lines 4-15) and the feed may have at least 43 carbon atoms present therein (see Srinivas, Table 2). Thus, Examiner submits that Srinivas inherently discloses a “feed mixture [having] an oxygen-to-carbon ratio of below 0.10.” With respect to catalyst support, Mackrodt notes that yttria is conventionally incorporated into zirconia supports as a means of stabilizing the zirconia against the phase change and accompanying volume expansion of unstabilized zirconia at elevated temperatures (see Mackrodt, column 4, lines 2-7).

Therefore, the person having ordinary skill in the art would have been motivated to incorporate yttria into the zirconia catalyst support of Srinivas (as taught by Mackrodt) in order to stabilize the zirconia against phase change and accompanying volume expansion at elevated temperatures.

Finally the person having ordinary skill in the art would have had a reasonable expectation of success in modifying the process of Srinivas as described above because both Srinivas and Mackrodt are directed, in part, to the use of zirconia-supported oxidation catalysts.

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16. Claims 25, 26, 30, and 33-44 are rejected under 35 U.S.C. 103(a) as being unpatentable over Srinivas (US 7,060,233) in view of Mackrodt (US 5,137,862) and D'Souza (US 4,233,276).

17. With respect to claims 25, 26, 30, and 33-44, see discussion *supra* at paragraph 15.

Srinivas does not explicitly disclose wherein his process further comprises removing the thus-formed sulfur dioxide from the gaseous product by adsorption on copper or barium oxide.

However, Srinivas discloses wherein his process may be operated upstream of other sulfur removal processes (see Srinivas, column 14, lines 46-62). In this regard, D'Souza discloses a process comprising catalytically oxidizing sulfur constituents in a gas stream (see D'Souza, column 6, lines 4-12) followed by the adsorptive removal of sulfur oxides formed in the oxidizing stage (see D'Souza, column 6, lines 13-20), the adsorbent comprising oxides of barium or copper (see D'Souza, column 6, lines 20-25).

Therefore, the person having ordinary skill in the art would have been motivated to modify the process of Srinivas to include the adsorptive removal step of D'Souza in order to further treat the oxidation stage effluent and further remove the sulfur oxides formed therein and thereby prevent their release to the atmosphere.

Finally, the person having ordinary skill in the art would have had a reasonable expectation of success in modifying the process of Srinivas as described above because both Srinivas and D'Souza are directed to processes for the oxidative removal of sulfur species in a gas stream.

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18. Claims 45, 48, 65-69, and 75-79 are rejected under 35 U.S.C. 103(a) as being unpatentable over Srinivas (US 7,060,233) in view of Mackrodt (US 5,137,862) and Wachs (US 7,374,666).

19. With respect to claims 45, 48, 65-69, and 75-79, see discussion *supra* at paragraph 15.

Srinivas does not explicitly disclose wherein the catalyst additionally comprises zirconium and cerium.

However, Wachs discloses that cerium and zirconium are useful adjuvants that may be added to an oxidation catalyst designed for the oxidative desulfurization of a hydrocarbon stream containing sulfur compounds, such additives functioning to enhance catalytic activity of the oxidation catalyst.

Therefore, the person having ordinary skill in the art would have been motivated to modify the oxidation catalyst of Srinivas to incorporate zirconium and cerium as activity enhancers. In this regard, Examiner notes that the combination of prior art elements (zirconium, cerium) known to be (individually) useful for the exact same purpose (to enhance the activity of an oxidation catalyst) supports a finding of *prima facie* obviousness. See MPEP § 2144.06.

20. Claims 51 and 85-89 are rejected under 35 U.S.C. 103(a) as being unpatentable over Srinivas (US 7,060,233) in view of Mackrodt (US 5,137,862), D'Souza (US 4,233,276), and Wachs (US 7,374,666).

With respect to claims 51 and 85-89, see discussion *supra* at paragraphs 17 and 19.

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21. Claims 46, 47, 49, 50, 70-74, and 80-84 are rejected under 35 U.S.C. 103(a) as being unpatentable over Srinivas (US 7,060,233) in view of Madgavkar (US 4,382,912).

22. With respect to claims 46, 47, 49, 50, 70-74, and 80-84, Srinivas discloses a process for the catalytic selective oxidation of a sulfur compound contained in a hydrocarbonaceous feedstock (e.g., natural gas, synthesis gas, natural gas liquids) to sulfur dioxide (see Srinivas, column 3, lines 17-20; column 4, lines 31-37; column 6, lines 7-11; and column 15, lines 40-45) comprising: contacting a mixture of a hydrocarbonaceous feedstock (see Srinivas, column 3, lines 17-20) containing any of various sulfur compounds (see Srinivas, column 3, lines 20-22; and column 4, lines 28-30) in an amount ranging from 100 ppm to 10,000 ppm (see Srinivas, column 23, lines 15-19) and an oxygen-containing gas (see Srinivas, column 5, lines 4-7) with a catalyst (see Srinivas, column 10, lines 14-26) at a temperature between about 160°C and 500°C (see Srinivas, column 4, lines 57-67; and column 5, lines 1-3) and a pressure in the range of 1 atm and 1000 psig (1.01 bar to 68.9 bar) (see Srinivas, column 6, lines 19-23), wherein the catalyst may comprise platinum, rhodium, or iridium in the range of 1 wt% to 10 wt% (see Srinivas, column 12, lines 56-59), supported on a catalyst carrier (e.g., zirconia) (see Srinivas, column 10, lines 27-30).

Srinivas does not explicitly disclose wherein the feed mixture has an oxygen-to-carbon ratio of below 0.10. Srinivas also does not explicitly disclose wherein his catalyst carrier is a non-refractory oxide bulk material.

However, Examiner notes wherein Applicant has defined “oxygen-to-carbon ratio” as “the ratio of oxygen in the form of molecules (O<sub>2</sub>) to carbon atoms present in

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the hydrocarbonaceous feedstock” (see Applicant’s specification, page 6, lines 17-19). In this regard, Srinivas discloses wherein the oxidizing gas is O<sub>2</sub> (see Srinivas, column 5, lines 4-15) and the feed may have at least 43 carbon atoms present therein (see Srinivas, Table 2). Thus, Examiner submits that Srinivas inherently discloses a “feed mixture [having] an oxygen-to-carbon ratio of below 0.10.” Moreover, Srinivas discloses that his catalyst support material may be titania, zirconia, silica, alumina, or mixtures thereof (see Srinivas, column 10, lines 27-30). In this regard, Madgavkar discloses the use of Fecralloy™ as a substitute for the support materials listed in Srinivas for the purpose of supporting oxidation catalysts (see Madgavkar, column 3, lines 16-37). Applicant admits that Fecralloy™ consists of Fe, Cr, and Al alloy with an alumina and zirconia surface layer (see Applicant’s specification, page 4, lines 33-34; and page 5, lines 1-4).

Therefore, Examiner finds Applicant’s claims 46, 47, 49, 50, 70-74, and 80-84 unpatentable over Srinivas in view of Madgavkar because the mere substitution of one prior art element (non-refractory oxide bulk catalyst support material of Madgavkar) for another prior art element (alumina, silica, titania, zirconia catalyst supports of Srinivas) known to be useful for the exact same purpose (as a support material for oxidation metals) supports a finding of *prima facie* obviousness. See MPEP § 2144.06.

23. Claims 52, 53, and 90-94 are rejected under 35 U.S.C. 103(a) as being unpatentable over Srinivas (US 7,060,233) in view of Madgavkar (US 4,382,912) and D’Souza (US 4,233,276).

24. With respect to claims 52, 53, and 90-94, see discussion *supra* at paragraph 22.

Srinivas does not explicitly disclose wherein his process further comprises removing the thus-formed sulfur dioxide from the gaseous product by adsorption on copper or barium oxide.

However, Srinivas discloses wherein his process may be operated upstream of other sulfur removal processes (see Srinivas, column 14, lines 46-62). In this regard, D'Souza discloses a process comprising catalytically oxidizing sulfur constituents in a gas stream (see D'Souza, column 6, lines 4-12) followed by the adsorptive removal of sulfur oxides formed in the oxidizing stage (see D'Souza, column 6, lines 13-20), the adsorbent comprising oxides of barium or copper (see D'Souza, column 6, lines 20-25).

Therefore, the person having ordinary skill in the art would have been motivated to modify the process of Srinivas to include the adsorptive removal step of D'Souza in order to further treat the oxidation stage effluent and further remove the sulfur oxides formed therein and thereby prevent their release to the atmosphere.

Finally, the person having ordinary skill in the art would have had a reasonable expectation of success in modifying the process of Srinivas as described above because both Srinivas and D'Souza are directed to processes for the oxidative removal of sulfur species in a gas stream.

### ***Response to Arguments***

25. Applicant's arguments filed 20 January 2011 have been fully considered but they are not persuasive.

26. Examiner understands Applicant's arguments to be:



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- I. The transitional phrase "consisting essentially of" functions to exclude a two component catalyst system such as that disclosed in Frame, which contains a major proportion of a Group VIIB metal phthalocyanine as an essential component. Therefore, it would be inappropriate and clear error for the Examiner to construe the transitional phrase "consisting essential of" as "comprising."
- II. The fact that Frame's oxidation process requires a medium having a pH of from 8 to 14 and requires the addition of an alkaline material, while the claimed process does not is believed to be relevant to the issue of obviousness in that it establishes a clear advantage for the claimed process. Moreover, it demonstrates the significant differences between the respective processes.
- III. In order to modify the process of Frame to arrive at the claimed process, one would have to change the catalyst system from a two-component system to a single component system which is contrary to Frame's disclosure.
- IV. In order to modify the process of Frame to arrive at the claimed process, one would have to modify the severity of the oxidation conditions to produce sulfur dioxide instead of sulfur and disulfides products disclosed in Frame.
- V. The sulfur compounds in Frame are not selectively oxidized to sulfur dioxide as required by the claimed process.
- VI. There is no disclosure in Yoo of a catalyst based on a Group VIII noble metal.
- VII. Examiner's calculated value of oxygen-to-carbon ratio is not reflective of the overall teachings of Yoo, appears to be based in part on an incorrect assumption, and also appears to involve impermissible hindsight reasoning.

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- VIII. Since Yoo teaches a range of active oxygen atoms to sulfur of 0.5 to 10, and also teaches that the hydrocarbon material generally has a sulfur content greater than 1 wt%, it is unclear why the Examiner chose the specific oxygen to sulfur ratio of 0.5 and a sulfur content of 1 wt% for the calculation.
- IX. Since hydrocarbon feeds contain hydrogen as well as carbon, and typically contain various amounts of sulfur compounds and nitrogen compounds, it is highly unlikely that carbon atom content of the feed would ever be 99% as assumed by Examiner.
- X. The fact that Examiner could not find a disclosure of oxygen-to-carbon ratio of below 0.15 in any of the cited references, and had to resort to a calculated value based on another ratio (oxygen to sulfur) is itself evidence of the unobviousness of the oxygen-to-carbon ratio limitations in the claimed process.
- XI. The Mahadev process is a two-step process involving the absorption of sulfur compounds from a fluid stream and then the subsequent decomposition of such compounds into elemental sulfur, which is a significantly different process from that of Frame.
- XII. The Mahadev catalyst is an alkali metal sulfide and sulfide or selenide of metal having polyvalent and/or amphoteric character on a microporous support, which is not even remotely similar to the metal phthalocyanine catalyst of Frame.
- XIII. It would not be obvious to modify the process of Frame, which uses a two-component metal phthalocyanine catalyst to oxidize up to 10 wt% hydrogen sulfide in natural gas "in order to preserve the adsorptive capacity of the catalyst."
- XIV. With respect to claim 20, Examiner cites Mahadev for its disclosure of a flue gas having a concentration of sulfur dioxide in the range of 1000 ppm to 2000 ppm. Flue gas is obviously a gas and not a liquid as required by claim 20, nor is flue gas a hydrocarbonaceous feedstock.

- XV. Mahadev does not teach or suggest a catalyst similar to that used in the claimed process, nor a feed mixture of hydrocarbonaceous feedstock and a molecular-oxygen containing gas having an oxygen-to-carbon ratio of below 0.15, which is important to achieving selective oxidation of sulfur compounds with no or minimal oxidation of hydrocarbon compounds.
- XVI. Mackrodt teaches away from the claimed process in which a Group VIII noble metal is employed as the essential catalytic component and which process is conducted at temperatures below 500 °C.
- XVII. None of the cited references disclose concentration ranges for catalysts which selectively oxidize various sulfur compounds to sulfur dioxide with no or minimal oxidation of non-sulfur containing hydrocarbonaceous compounds.

27. With respect to Applicant's first argument, Examiner notes that the Board decision rendered 31 August 2009 in the instant application fully supports Examiner's construction of "consisting essentially of" the same as "comprising" when interpreting Applicants claim 1. Specifically, the Board found:

Appellant's Specification supports interpreting the claim to allow the inclusion of other compounds (FF 1). This interpretation of claim 1 is further supported by the claim language requiring the Group VIII noble metal only be present in the catalyst in a concentration of 0.02% to 10% by weight based on the total weight of the catalyst (see claim 1). As such, the remaining 90 to 98.8% of the catalyst must comprise one or more additional components, and the claim is silent as to what those additional components may be (Board decision mailed 1 September 2009, page 5).

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28. With respect to Applicant's second argument, Examiner notes that the same argument was previously argued on appeal and found to be not persuasive by the Board (see Board decision mailed 1 September 2009, pages 5-6).

29. With respect to Applicant's third argument, because Examiner construes Applicant's transitional phrase "consisting essentially of" the same as "comprising" to define the catalyst used in the claimed process, such argument is not persuasive because additional elements are not excluded with the use of such catalyst.

30. With respect to Applicant's fourth and fifth arguments, Frame provides that "[t]he oxidation conditions of the present invention include a temperature of from about 0°C to about 500°C and preferably from about 50°C to about 400°C and a pressure from about 1 atmosphere to about 100 atmospheres" (see Frame, column 3, lines 1-5) which is entirely overlapping with oxidation conditions of the claimed process having "a temperature of at most 500°C" (see, e.g., claim 1) and "a pressure in the range of from 1 to 10 bar (absolute)" (see, e.g., claim 11). Thus, because Frame discloses the exact oxidation conditions as are used in the claimed process, then some level of sulfur dioxide must necessarily (inherently) be produced in the process of Frame, even if the disclosure is silent on this feature.

31. With respect to Applicant's sixth argument, Frame (not Yoo) is cited for disclosure of such feature. One cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. See In re Keller, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); In re Merck & Co., 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986).

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32. With respect to Applicant's seventh, eighth, ninth, and tenth arguments, Examiner begins by noting that Applicant's specification does not provide even a single example of how exactly the "oxygen-to-carbon" ratio is to be calculated. Rather, the specification merely provides that "Reference herein to the oxygen-to-carbon ratio is to the ratio of oxygen in the form of molecules ( $O_2$ ) to carbon atoms present in the hydrocarbonaceous feedstock" (specification, page 6, lines 16-19). Looking to the specific examples provided in the specification, Applicant provides that the  $O_2/C$  ratio was 0.005 when the hydrocarbonaceous feedstock was methane (having 1 carbon atom) (specification, page 13, lines 7-14) whereas the  $O_2/C$  ratio was 0.002 when the hydrocarbonaceous feedstock was a mixture of propane and butane (having a total of 7 carbon atoms) (specification, page 13, lines 24-25; and page 14, lines 1-5). Turning to Yoo, his disclosure provides for an oxygen-to-sulfur ratio from about 0.5 to about 10 (see Yoo, column, lines 55-57) and a specific example with propane as the hydrocarbonaceous feed and a sulfur-to-carbon ratio of  $1.73/85.8 = 0.020$ . Doing the necessary math, one obtains an oxygen-to-carbon ratio of 0.01 to 0.20 which includes a range "below 0.15" as provided for in the claimed process. Should Applicant take issue with Examiner's calculation, then Applicant should provide a detailed explanation and/or a specific example of such calculation that is supported by and consistent with information provided in the specification.

33. With respect to Applicant's eleventh, twelfth, and thirteenth arguments, Examiner notes that such arguments were previously argued on appeal before the

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Board with the Board ultimately affirming all of the rejections in view of the same references.

34. With respect to Applicant's fourteenth argument, Examiner notes that the disclosure of Mahadev is not limited to the treatment of "flue gas." Rather, Mahadev makes clear that "[his catalyst] is suitable for removing [organic-sulfur compounds] from a mixture of more complex natural gas components in gaseous or liquid phase, such as from butane or propane, and including, generally, natural gas liquids" (see Mahadev, page 29, lines 11-15).

35. With respect to Applicant's fifteenth argument, Frame (not Mahadev) is cited for disclosure of such features. One cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. See In re Keller, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); In re Merck & Co., 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986).

36. With respect to Applicant's sixteenth argument, Frame (not Mackrodt) is cited for disclosure of such features. One cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. See In re Keller, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); In re Merck & Co., 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986).

37. With respect to Applicant's seventeenth argument, Frame provides that "[t]he oxidation conditions of the present invention include a temperature of from about 0°C to about 500°C and preferably from about 50°C to about 400°C and a pressure from about 1 atmosphere to about 100 atmospheres" (see Frame, column 3, lines 1-5) which is

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entirely overlapping with oxidation conditions of the claimed process having “a temperature of at most 500°C” (see, e.g., claim 1) and “a pressure in the range of from 1 to 10 bar (absolute)” (see, e.g., claim 11). Thus, because Frame discloses the exact oxidation conditions as are used in the claimed process, then the process of Frame must necessarily (inherently) proceed “with no or minimal oxidation of the non-sulfur containing hydrocarbonaceous compounds.” Regarding the specific concentration ranges of catalysts being disclosed, Examiner notes that the Board has already considered such argument and found it to be nonpersuasive (see Board decision mailed 1 September 2009, page 10) (“We find the Examiner's reasoning persuasive since one of ordinary skill in the art would have been capable of determining workable amounts of group VIII noble metals present in the catalyst system by routine experimentation.”).

38. The remainder of Applicant's arguments is considered moot in view of the new grounds for rejection.

***Conclusion***

39. Applicant's amendment necessitated the new grounds of rejection presented in this Office Action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

40. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Randy Boyer whose telephone number is (571) 272-7113. The examiner can normally be reached Monday through Friday from 10:00 A.M. to 7:00 P.M. (EST).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Glenn A. Caldarola, can be reached at (571) 272-1444. The fax number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for



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/Randy Boyer/

Examiner, Art Unit 1771

/Glenn A Caldarola/

Supervisory Patent Examiner, Art Unit 1771